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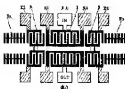
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(22)Date of filing : 20.02.1998 (72)Inventor : WATANABE YOSHIHISA

(54) SAW FILTER



(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the package size while maintaining excellent filter characteristics by connecting a comb-shaped electrode which constitutes one IDT electrode and a pad electrode for wiring through the outermost electrode finger of the comb-shaped electrode. SOLUTION: On a piezoelectric substrate, three IDT electrodes 1 to 3 are arranged closely along the propagation direction of a surface wave and on both the sides of them, reflectors Ra and Rb are arranged to constitute a double SAW mode filter; and two double SAW mode filters are arranged on the same piezoelectric substrate and electrically connected by lead electrodes. The lead electrode of a comb-shaped electrode arranged outside the IDT electrode 1 is extended outward and connected to an input bonding pad IN. Further, the lead electrodes from the outermost electrode fingers of the IDT electrode 1 are extended outward

respectively and connected to bonding pads E2 and E3 for a ground potential. Further, the lead electrodes from the comb-shaped electrodes arranged outside the IDT electrodes 2 and 3 are extended outward respectively and connected to bonding pads E1 and E4 for the ground potential.

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CLAIMS

[Claim(s)]

[Claim 1] The SAW filter characterized by to constitute so that the radial fin type electrode and the pad electrode for wiring which

constitute at least one of the IDT electrodes of said multiplex-mode SAW filter may be connected through the outermost electrode finger of the radial fin type electrode concerned in the cascade connection type length joint multiplex-mode SAW filter which put side by side two vertical joint multiplex-mode SAW filters which have arranged two or more IDT electrodes along the propagation direction of a surface wave on a piezo-electric substrate, and performed cascade connection.
[Claim 2] The SAW filter according to claim 1 characterized by having arranged the pad electrode for wiring on the outside of said cascade connection type length joint multiplex-mode SAW filter.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the surface acoustic wave filter which has improved the drawer means of the lead electrode of a vertical joint multiplex-mode SAW filter, and was miniaturized about the surface acoustic wave filter (an SAW filter is called hereafter) of a resonator mold.

[0002]

[Description of the Prior Art] In recent years, an SAW filter is used in many communication link fields, and is bearing a wing of spread, such as a cellular phone, from the descriptions, such as high performance, small, and mass-production nature. Drawing 8 is the top view showing an example of the IDT electrode configuration of the primary vertical joint 3rd [-] dual mode SAW filter (a dual mode SAW filter is called hereafter) which is one sort of a resonator mold filter, on the principal plane of the piezo-electric substrate 11, carries out contiguity arrangement of

the three IDT electrodes 12, 13, and 14 along the propagation direction of a surface wave, and arranges Reflectors 15a and 15b at the both sides of these IDT. The IDT electrodes 12, 13, and 14 are constituted by the radial fin type electrode of the pair which has two or more electrode fingers put mutually in between, respectively, they are the IDT electrodes 12, while go away, connect a form electrode to an input terminal, and ground the radial fin type electrode of another side. And it is the IDT electrode 13 and the IDT electrode 14, while it goes away, the form electrode of each other is connected and is connected to an output terminal, it connects mutually and the radial fin type electrode of another side of the IDT electrodes 13 and 14 is grounded.

[0003] The primary vertical resonance mode [3rd] of 2 is excited by stress, and the actuation of a dual mode SAW filter shown in drawing 8 operates as a dual mode SAW filter using these two modes, as a result of shutting up two or more surface waves excited with the IDT electrodes 12, 13, and 14 among Reflectors 15a and 15b and producing an acoustic turnover among said IDT electrodes 12, 13, and 14 as everyone knows. In addition, it is well-known that the passband of this dual mode SAW filter is proportional to the delta frequency of primary resonance mode and the 3rd resonance mode.

[0004] As shown in drawing 8, the technique which the breadth of the outermost electrode finger of the IDT electrode 12 forms more broadly than the breadth of other electrode fingers is known. This is the result of sticking the electrode finger comrade by the side of the innermost [of the IDT electrodes 12 and 13 and the IDT electrodes 12 and 14] in order to extend the bandwidth of a dual mode SAW filter to the maximum extent (JP, 5-267990, A). Moreover, when desired attenuation slope or the desired guarantee magnitude of attenuation are not obtained in the dual mode SAW filter simple substance shown in drawing 8, as shown in drawing 9, it is the technique of the common knowledge as a means which two duplex mode filters are put side by side on a piezo-electric substrate, and the cascade connection mold dual mode SAW filter (2 section SAW filter is called hereafter) which carried out cascade connection of them electrically is used, and improves attenuation slope and the guarantee magnitude of attenuation. The frequency characteristics of the filter made as an experiment using the layout of the IDT electrode pattern of 2 section SAW filter shown in drawing 9, a reflector, a lead electrode, and a bonding pad are shown in drawing 10. Center frequency is [25MHz or more and the insertion loss of 800MHZ bands and bandwidth] about 2.3dB, and a package dimension is 3.8mm angle. A majority of these 2 section SAW filters are used as an RF

filter of a cellular phone.

[0005]

[Problem(s) to be Solved by the Invention] if 2 section SAW filter shown in above-mentioned drawing 9 is applied to the broadband 2 section SAW filter for the pocket bells of a 150MHz band, since [however,] the period of the electrode finger of an IDT electrode is inversely proportional to a frequency -- 150MHz and a comparatively low frequency -- many electrode fingers -- there was a problem that a logarithm was needed, the size of a piezo-electric substrate became large, and package size became large as a result. Furthermore, when the size of one filter became large, the filter number per one wafer also decreased and there was a problem of becoming expensive in cost. Therefore, the transversal SAW filter using a float electrode mold internal reflection one side tropism IDT electrode (FEUDT is called hereafter) as shown in drawing 11 with a miniaturization easy until now comparatively was used. However, when the broadband SAW filter of a 150MHz band is manufactured, as shown in drawing 12 , while a a little more than 1dB ripple arises in a band, the insertion loss in a passband becomes large compared with a dual mode SAW filter. There was a problem of it becoming impossible to be satisfied with a transversal mold SAW filter a demand of a user with eye the ** and high-performance-izing of electronic equipment in recent years. It is made in order that this invention may solve the above-mentioned problem, and it aims at offering the two-step cascade connection dual mode SAW filter which made package size small, with the good filter shape of a dual mode SAW filter maintained.

[0006]

[Means for Solving the Problem] Invention of the surface acoustic wave filter applied to this invention in order to attain the above-mentioned purpose according to claim 1 In the cascade connection type length joint multiplex-mode SAW filter which put side by side two vertical joint multiplex-mode SAW filters which have arranged two or more IDT electrodes along the propagation direction of a surface wave on a piezo-electric substrate, and performed cascade connection It is the SAW filter characterized by constituting so that the radial fin type electrode and the pad electrode for wiring which constitute at least one of the IDT electrodes of said multiplex-mode SAW filter may be connected through the outermost electrode finger of the radial fin type electrode concerned. SAW filter according to claim 1 characterized by invention according to claim 1 having arranged the pad electrode for wiring on the outside of said cascade connection type length joint multiplex-mode SAW filter it is .

[0007]

[Embodiment of the Invention] This invention is explained to a detail based on the gestalt of operation shown in the drawing below. Drawing 1 is the 1st example concerning this invention, and is drawing showing an example of arrangement of the electrode layout at the time of applying to a primary 3rd [-] length joint dual mode SAW filter (dual mode SAW filter), i.e., an IDT electrode, a reflector, a lead electrode, and a bonding pad. Contiguity arrangement of the three IDT electrodes 1, 2, and 3 is carried out along the propagation direction of a surface wave on a piezo-electric substrate, the duplex SAW mode filter which comes to arrange Reflectors Ra and Rb in the both sides is put side by side on [two] the same piezo-electricity substrate, it connects electrically using a lead electrode, and a dual mode SAW filter constitutes 2 section SAW filter. Since the layout of the electrode pattern of said 2 section SAW filter is symmetrical with drawing Nakagami down, explanation is given only in drawing Nakagami one half. However, the input bonding pad of an upper half does not need to say replacing an output bonding pad with the layout of a lower half.

[0008] If the layout of the lead electrode of drawing 1 and a bonding pad is explained, the lead electrode from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 1 will be extended in the direction of an outside, and it will connect with the bonding pad IN for an input. Moreover, the lead electrode from the outermost electrode finger of the IDT electrode 1 is extended in the direction of an outside, respectively, and it connects with the bonding pads E2 and E3 for ground potentials, respectively. Furthermore, the lead electrode from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrodes 2 and 3 is extended in the direction of an outside, respectively, and it connects with the bonding pads E1 and E4 for ground potentials. In order to clarify distinction with the bonding pads IN and OUT for signals, and the bonding pads E1-E4 for ground potentials, the slash was attached to the lead electrode prolonged from that of the bonding pads E1-E4 for ground potentials, and this pad, and the pad for signals and the lead electrode were considered as void.

[0009] As only the lead electrode prolonged from the radial fin type electrode arranged to the drawing Nakauchi side with IDT 2 and 3 performs electrical installation between two dual mode SAW filters in the case of 2 section SAW filter of drawing 1 and all of the input bonding pad IN, the output bonding pad OUT, and a ground pad are shown in drawing 1, the layout arranged to the bottom of both the outsides of

the direction of a short hand of 2 section SAW filter, i.e., drawing Nakagami, is the description of this invention. thus -- although the dimension of the longitudinal direction in drawing is decided by the dimension of the IDT electrodes 1, 2, and 3 and Reflectors Ra and Rb and there is no change of magnitude by considering a bonding pad as arrangement -- a drawing Nakagami down dimension -- from the bonding pad IN for an input up to the bonding pad OUT for an output -- becoming -- the dimension (dimension of the vertical direction of drawing 9) of the direction of a short hand of the conventional 2 section SAW filter -- it can compare and can be sharply made small. As for the vertical joint multiplex-mode SAW filter, it was common to have been used with a high frequency band called a 800MHz band until now, and since the width of face of the electrode finger which constitutes an IDT electrode was thin, there was no way of thinking of using a trowel as a lead electrode. That is, it is because it thought that an ohmic loss increased by the thinness of a lead. This invention is characterized by using an electrode finger for wiring with a pad electrode paying attention to making the outermost electrode finger of an IDT electrode thicker than others in that the width of face of an electrode finger becomes large in a comparatively low frequency band, and a vertical joint multiplex-mode SAW filter.

[0010] It is the top view showing the layout of the IDT electrode of the 2nd example concerning this invention, a reflector, a lead electrode, and a bonding pad, and since this drawing is also point symmetry, as for drawing 2, it explains only an upper half to drawing Nakagami down. Moreover, it supposes that the same notation as drawing 1 is hereafter used for the IDT electrode which achieves the same function as drawing 1, a reflector, and a bonding pad, and the explanation is omitted. It is in the point which can reduce one bonding pad for ground potentials by bypassing the bonding pad IN for an input and connecting to one bonding pad E6 for ground potentials each lead electrode prolonged from the outermost electrode finger of the IDT electrode 1. By the above layout configurations of a lead electrode and a bonding pad, the number of bonding pads can be decreased to eight pieces compared with drawing 1, and the man day of bonding can be reduced.

[0011] Drawing 3 is the top view showing the layout of the IDT electrode of the 3rd example concerning this invention, a reflector, a lead electrode, and a bonding pad, and since this layout is also symmetrical with the vertical direction, it explains only an upper half. It supposes that the same notation as drawing 1 is hereafter used for the IDT electrode which achieves the same function as drawing 1, a reflector,

and a bonding pad, and the explanation is omitted. It is characterized by considering this example as the layout configuration which connected the lead electrode prolonged from each lead electrode prolonged from two outermost electrode fingers of the IDT electrode 1, and the radial fin type electrode arranged on the outside of IDT 2 and 3 to the bonding pads E8 and E9 for a ground arranged in each near, respectively. While making 2 section SAW filter small by considering as such a layout configuration, it is also possible to reduce the number of bonding pads with six pieces, and to reduce a bonding man day.

[0012] Drawing 4 is the 4th example concerning this invention, it is the top view showing the layout of the IDT electrode of 2 section SAW filter, a reflector, a lead electrode, and a bonding pad, and about the center, since a filter is point symmetry, it explains only Fig. Nakagami one half. It supposes that the same notation as drawing 1 is hereafter used for the IDT electrode which achieves the same function as drawing 1, a reflector, and a bonding pad, and the explanation is omitted. It is 2 section SAW filter considered as the layout which connected to one each lead electrode prolonged from two outermost electrode fingers of the IDT electrode 1 in this example, and the lead electrode prolonged, respectively from the radial fin type electrode arranged to the drawing Chugai side of IDT 2 and 3, and was connected to one bonding pad E10 for ground potentials. While making the dimension of the cross direction of said filter small by considering as such a layout, it becomes possible to reduce the number of bonding pads with four pieces, and a bonding man day can be reduced.

[0013] Drawing 5 is the top view showing the layout of the IDT electrode of 2 section SAW filter, a reflector, a lead electrode, and a bonding pad in the 5th example concerning this invention, and about the center, since it is symmetrical with the bottom of drawing Nakagami, this filter also explains only the upper half of a Fig. The SAW filter shown in drawing 5 differs from the SAW filter shown in drawing 1 - drawing 4. The lead electrode from the radial fin type electrode which connected with the bonding pad IN for an input, respectively, and has arranged the lead electrode prolonged from the radial fin type electrode arranged on the outside of the IDT electrodes 2 and 3 to the drawing Chugai side of the IDT electrode 1, It considers as the layout configuration which connected to the bonding pad E11 of one ground potential each lead electrode prolonged from two electrode fingers by the side of the innermost [of the IDT electrodes 2 and 3], respectively. Moreover, electrical installation between dual mode SAW filters The lead electrode prolonged from the radial fin type electrode arranged to the drawing

Nakauchi side of the IDT electrode 1 performs. Therefore, a bonding pad becomes four pieces, and it can reduce a bonding man day while it makes 2 section SAW filter small.

[0014] Drawing 6 is the 6th example concerning this invention, it is the top view showing the layout of the IDT electrode of 2 section SAW filter, a middle grating, a reflector, a lead electrode, and a bonding pad, and about the center, since it is symmetrical with the bottom of drawing Nakagami, this SAW filter also explains only the upper half of a Fig. This SAW filter is a primary vertical joint 3rd [-] dual mode SAW filter which arranged the middle gratings Ma and Mb arranged between the IDT electrode 1 and 2 and between 1 and 3 unlike the dual mode SAW filter of drawing 1 - drawing 5. Thus, if a middle grating is arranged to IDT inter-electrode, this filter can adjust an I/O impedance with the electrode characteristic of said middle grating, or can be operated as 3rd [-] primary 5th [-] Mie mode SAW filter. The lead electrode prolonged in the direction of an outside from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 1 is connected to the bonding pad IN for an input. Furthermore, the lead electrode prolonged from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 2 and the lead electrode prolonged from the middle grating Ma are connected to the bonding pad E12 of ground potential, respectively. And it considers as the layout configuration which connected to the bonding pad E13 of ground potential the lead electrode prolonged from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 3, and the lead electrode prolonged from the middle grating Mb, respectively. By considering as such a layout configuration, while it is possible to make 2 section SAW filter small, a bonding man day is reducible.

[0015] Drawing 7 is the 7th example concerning this invention, it is the top view showing the layout of the IDT electrode of a primary cascade connection mold 5th [-] dual mode SAW filter, a reflector, a lead electrode, and a bonding pad, and about the center, since it is symmetrical with the bottom of drawing Nakagami, this SAW filter also explains only the upper half of a Fig. The lead electrode prolonged from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 1 and the lead electrode prolonged, respectively from two electrode fingers by the side of the innermost [of the IDT electrodes 2 and 3] are connected to the bonding pad E15 of one ground potential. Furthermore, the lead electrode prolonged, respectively from the radial fin type electrode arranged to the drawing Chugai side of the IDT electrodes 2 and 3 is connected to the input bonding pad IN. And the

lead electrode prolonged from the lead electrode prolonged from the outermost electrode finger of the IDT electrode 2 and the radial fin type electrode arranged to the drawing Chugai side of the IDT electrode 4 is connected to the bonding pad E14 of nearby ground potential. Moreover, it considers as the layout configuration which connected to bonding pad ** 16 of nearby ground potential the lead electrode prolonged from the lead electrode prolonged from the outermost electrode finger of the IDT electrode 3, and the radial fin type electrode arranged on the outside of the IDT electrode 5. Thus, by carrying out the layout of a lead electrode and a bonding pad, it is possible to make small a primary cascade connection mold 5th [-] length joint dual mode SAW filter.

[0016]

[Effect of the Invention] Since this invention was constituted as explained above, if it comes to especially 200MHz or less, it does so a comparatively low frequency, 300MHz or less of for example, outstanding effectiveness that primary cascade connection mold the 3rd [-] primary 5th [-] dual mode SAW filter can be constituted small sharply.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the layout configuration of the primary cascade connection mold 3rd [-] length joint dual mode SAW filter of the 1st example concerning this invention.

[Drawing 2] It is the layout configuration of the primary cascade connection mold 3rd [-] length joint dual mode SAW filter of the 2nd example concerning this invention.

[Drawing 3] It is the layout configuration of the primary cascade

connection mold 3rd [-] length joint dual mode SAW filter of the 3rd example concerning this invention.

[Drawing 4] It is the layout configuration of the primary cascade connection mold 3rd [-] length joint dual mode SAW filter of the 4th example concerning this invention.

[Drawing 5] It is the layout configuration of the primary cascade connection mold 3rd [-] length joint dual mode SAW filter of the 5th example concerning this invention.

[Drawing 6] It is the 6th example concerning this invention, and is the layout configuration of the primary cascade connection mold 3rd [-] length joint dual mode SAW filter which inserted the middle grating into IDT inter-electrode.

[Drawing 7] It is the 7th example concerning this invention, and is the layout configuration of the primary cascade connection mold 5th [-] length joint dual mode SAW filter using five IDT electrodes.

[Drawing 8] It is the top view showing an example of the electrode configuration of a 3rd [-] dual mode SAW filter primary vertical joint [conventional].

[Drawing 9] It is the top view showing an example of the electrode configuration of a 3rd [-] dual mode SAW filter primary cascaded type length joint [conventional].

[Drawing 10] It is drawing showing an example of the filtering property of a 3rd [-] dual mode SAW filter primary cascaded type length joint [conventional].

[Drawing 11] It is the top view showing 1 electrode configuration of the transversal SAW filter using a float electrode mold internal reflection one direction nature IDT electrode (FEUDT).

[Drawing 12] It is drawing showing a filtering property example of a FEUDT transversal SAW filter.

[Description of Notations]

1, 2, 3, 4, 5 .. IDT electrode

Ra, Rb .. Reflector

IN .. Input

OUT .. Output

Ma, Mb .. Middle grating

E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16,
and .. the bonding pad of ground potential

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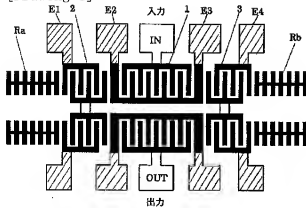
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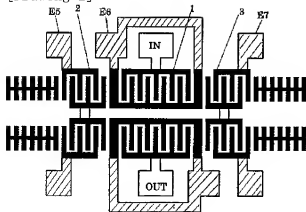
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DRAWINGS

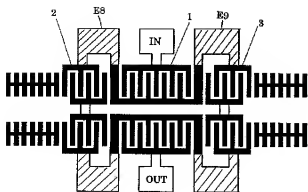
[Drawing 1]



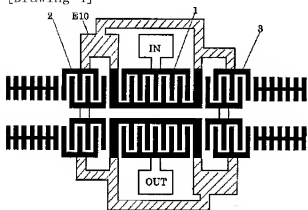
[Drawing 2]



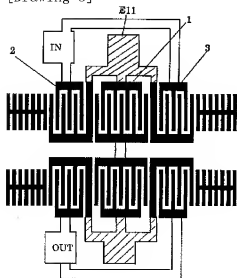
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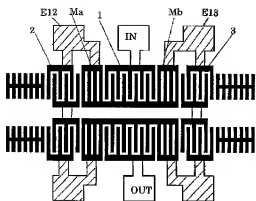
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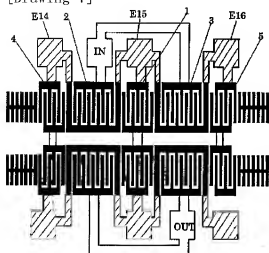
[Drawing 5]



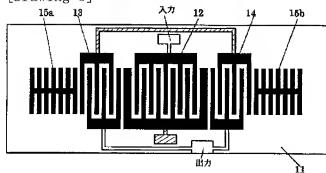
[Drawing 6]



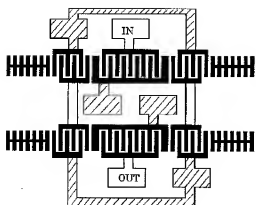
[Drawing 7]



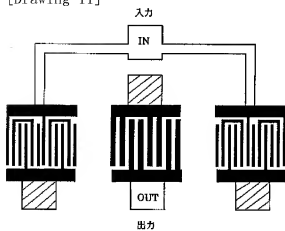
[Drawing 8]



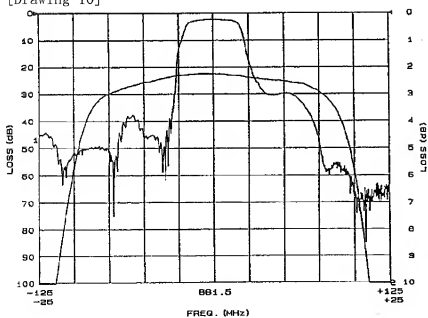
[Drawing 9]



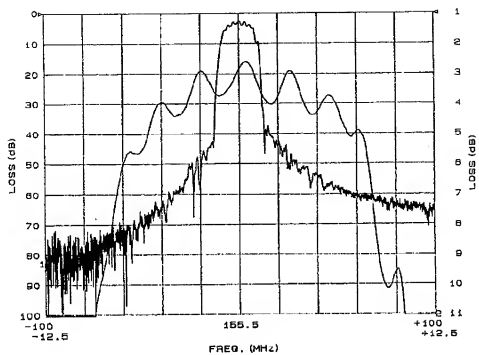
[Drawing 11]



[Drawing 10]



[Drawing 12]



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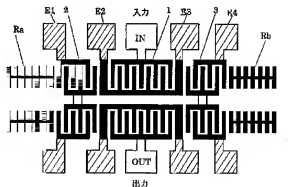
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(54) 【発明の名称】 SAWフィルタ

(57) 【要約】

【課題】 多段接続型縦結合多重モードSAWフィルタの外形状を削減する手段を得る。

【解決手段】 圧電基板上に表面波の伝播方向に沿って複数のIDT電極、反射器を配置して成る縦結合多重モードSAWフィルタを複数個併置した多段従属接続型縦結合多重モードSAWフィルタで、縦結合多重モードSAWフィルタ間はリード電極のみとし、ボンディング用パッドは前記フィルタの外周に配置する。



【特許請求の範囲】

【請求項1】 圧電基板上に表面波の伝播方向に沿って複数のIDT電極を配置した縦結合多重モードSAWフィルタを2個併置し縦接続を施した縦接続型縦結合多重モードSAWフィルタにおいて、前記多重モードSAWフィルタのIDT電極の少なくとも一つを構成するくし形電極と配線用のパッド電極とを当該くし形電極の最外側電極指を介して接続するよう構成したことを特徴とするSAWフィルタ。

【請求項2】 配線用パッド電極を前記縦接続型縦結合多重モードSAWフィルタの外側に配置したことを特徴とする請求項1記載のSAWフィルタ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は共振器型の弾性表面波フィルタ（以下、SAWフィルタと称す）に関し、特に縦結合多重モードSAWフィルタのリード電極の引き出し手段を改善して小型化した弾性表面波フィルタに関する。

【0002】

【従来の技術】 近年、SAWフィルタは多くの通信分野で用いられ、高性能、小型、量産性等の特徴から携帯電話等の普及の一翼を担っている。図8は、共振器型フィルタの一種である縦結合1次-3次二重モードSAWフィルタの一例を示す平面図であって、圧電基板11の主面上に表面波の伝播方向に沿って3つのIDT電極12、13及び14を近接配置し、これらIDTの両側に反射器15a、15bを配設したものである。IDT電極12、13、14はそれぞれ互いに間隔し合う複数本の電極指を有する一対のくし形電極により構成され、IDT電極12の一方のくし形電極は入力端子に接続し、他方のくし形電極は接地する。そして、IDT電極13とIDT電極14の一方のくし形電極は互いに連結して出力端子に接続し、IDT電極13と14の他方のくし形電極は互いに接続して接地する。

【0003】 図8に示す二重モードSAWフィルタの動作は、周知のように、IDT電極12、13、14によって励起される複数の表面波が反射器15a、15bの間に閉じ込められ、前記IDT電極12、13、14の間で音響結合を生ずる結果、1次と3次の縦共振モードが強勢に励振され、これらの2つのモードを利用した二重モードSAWフィルタとして動作する。なお、該二重モードSAWフィルタの通過帯域は1次共振モードと3次共振モードとの周波数差に比例することは周知のことである。

【0004】 図8に示すように、IDT電極12の最外側の電極指の幅目が他の電極指の幅目より幅広に形成する手法が知られている。これは二重モードSAWフィルタの帯域幅を最大限に広げるため、IDT電極12と1

3、IDT電極12と14の最内側の電極指間隔を密着させた結果である（特開平5-267990）。また、図8に示す二重モードSAWフィルタ単体では所望の減衰傾度や保証減衰量が得られないような場合には、図9に示すように、圧電基板上に二重モードフィルタを2個併置し、それらを電氣的に縦接続した縦接続型二重モードSAWフィルタ（以下、2セクションSAWフィルタと称す）が用いられ、減衰傾度及び保証減衰量を改善する手段として周知の手法である。図9に示す2セクションSAWフィルタのIDT電極パターン、反射器、リード電極及びボンディングパッドのレイアウトを用いて試作したフィルタの周波数特性を図10に示す。中心周波数は800MHz帯、帯域幅は25MHz以上、挿入損失は約2.3dBであり、パッケージ寸法は3.8mm角である。この2セクションSAWフィルタは例えば、携帯電話のRFフィルタとして多数用いられている。

【0005】

【発明が解決しようとする課題】 ところが、上記の図9に示す2セクションSAWフィルタを、150MHz帯のポケットベル用の広帯域2セクションSAWフィルタに適用すると、IDT電極の電極指の周期は周波数に逆比例するため、150MHzと比較的低い周波数では多数の電極指対数が必要となり圧電基板のサイズが大きくなり、その結果パッケージサイズが大きくなるという問題があった。さらに、1個のフィルタのサイズが大きくなると、1ウエハ当たりのフィルタ個数も減少しコスト的に高価になるという問題があった。そのため、これまで比較的小型化が容易な図11に示すような浮き電極型内部反射一方向性IDT電極（以下、FEUDTと称す）を用いたトランスバーサルSAWフィルタを用いていた。しかしながら、150MHz帯の広帯域SAWフィルタを製作した場合、図12に示すように帯域内に1dB強のリップルが生じると共に通過帯域における挿入損失が二重モードSAWフィルタに比べて大きくなる。そのため、近年の電子機器の高性能化に伴いトランスバーサル型SAWフィルタではユーザーの要求が満足できなくなるという問題があった。本発明は上記問題を解決するためになされたものであって、二重モードSAWフィルタの良好なフィルタ特性を維持したままパッケージサイズを小型にした2段縦接続二重モードSAWフィルタを提供することを目的とする。

【0006】

【課題を解決するための手段】 上記目的を達成するために本発明に係る弾性表面波フィルタの請求項1記載の発明は、圧電基板上に表面波の伝播方向に沿って複数のIDT電極を配置した縦結合多重モードSAWフィルタを2個併置し縦接続を施した縦接続型縦結合多重モードSAWフィルタにおいて、前記多重モードSAWフィルタのIDT電極の少なくとも一つを構成するくし形電

【0012】図4は本発明に係る第4の実施例で、2セクションSAWフィルタのIDT電極、反射器、リード電極及びボンディングパッドのレイアウトを示す平面図であり、フィルタはその中央に関して点対称であるため、図中上半分のみを説明する。図1と同じ機能を果たすIDT電極、反射器、ボンディングパッドには、以下、図

1と同じ記号を用いることとし、その説明を省略する。この実施例ではI D T電極1の最外側の2つの電極指から延びるそれぞれのリード電極と、I D T 2、3の図中外側に配置したくし形電極からそれぞれ延びるリード電極とを1つに結線し、1つのアース電位用のボンディングパッドE 10に接続したレイアウトとした2セクションSAWフィルタである。このようなレイアウトとすることにより、前記フィルタの端方向の寸法を小さくすると共に、ボンディングパッド数を4個と減らすことが可能となり、ボンディング工数を削減することができる。

【0013】図4は本発明に係る第5の実施例で2セクションSAWフィルタのI D T電極、反射器、リード電極及びボンディングパッドのレイアウトを示す平面図であり、本フィルタもその中央に関して図中上下対称であるため図の上半分のみについて説明する。図4に示すSAWフィルタは、図1〜図4に示したSAWフィルタと異なり、I D T電極2、3の外側に配置したくし形電極から延びるリード電極を、入力用ボンディングパッドI Nにそれぞれ接続し、I D T電極1の図中外側に配置したくし形電極からのリード電極と、I D T電極2、3の最内側の2つの電極指から延びるそれぞれのリード電極とを1つのアース電位のボンディングパッドE 11にそれぞれ接続したレイアウト構成とする。また、二重モードSAWフィルタ間の電気的接続はI D T電極1の図中外側に配置したくし形電極から延びるリード電極で行う。従って、ボンディングパッドは4個となり、2セクションSAWフィルタを小型にすると共にボンディング工数を削減することができる。

【0014】図6は本発明に係る第6の実施例で、2セクションSAWフィルタのI D T電極、ミドルグレーティング、反射器、リード電極及びボンディングパッドのレイアウトを示す平面図であり、本SAWフィルタもその中央に関して図中上下対称であるため図の上半分のみについて説明する。本SAWフィルタは図1〜図5の二重モードSAWフィルタと異なり、I D T電極1、2間および1、3間に配置したミドルグレーティングMa、Mbを配設した縦結合1次〜3次二重モードSAWフィルタである。このようにI D T電極間にミドルグレーティングを配置すると、このフィルタは前記ミドルグレーティングの電極指数により入出力インピーダンスを調整したり、あるいは1次〜3次〜5次二重モードSAWフィルタとして機能させることができる。I D T電極1の図中外側に配置したくし形電極から外側方向に延びるリード電極を入力用ボンディングパッドI Nに接続する。さらに、I D T電極2の図中外側に配置したくし形電極から延びるリード電極とミドルグレーティングMaから延びるリード電極をアース電位のボンディングパッドE 12にそれぞれ接続する。そして、I D T電極3の図中外側に配置したくし形電極から延びるリード電極とミドルグレーティングMbから延びるリード電極をアース電

位のボンディングパッドE 13にそれぞれ接続したレイアウト構成とする。このようなレイアウト構成とすることにより、2セクションSAWフィルタを小型にすることが可能であると共にボンディング工数を削減できる。

【0015】図7は本発明に係る第7の実施例で、縦線接続型1次〜5次二重モードSAWフィルタのI D T電極、反射器、リード電極及びボンディングパッドのレイアウトを示す平面図であり、本SAWフィルタもその中央に関して図中上下対称であるため図の上半分のみについて説明する。I D T電極1の図中外側に配置したくし形電極から延びるリード電極と、I D T電極2、3の最内側の2つの電極指からそれぞれ延びるリード電極とを1つのアース電位のボンディングパッドE 15に接続する。更に、I D T電極2、3の図中外側に配置したくし形電極からそれぞれ延びるリード電極を入力ボンディングパッドI Nに接続する。そして、I D T電極2の最外側の電極指から延びるリード電極と、I D T電極4の図中外側に配置したくし形電極から延びるリード電極を近傍のアース電位のボンディングパッドE 14に接続する。また、I D T電極3の最外側の電極指から延びるリード電極と、I D T電極5の外側に配置したくし形電極から延びるリード電極を近傍のアース電位のボンディングパッドE 16に接続したレイアウト構成とする。このようにリード電極及びボンディングパッドのレイアウトとすることにより、縦線接続型1次〜5次縦結合二重モードSAWフィルタを小型にすることが可能である。

【0016】

【発明の効果】本発明は、以上説明したように構成したので、比較的低周波数、例えば300MHz以下、特に200MHz以下においては、縦線接続型1次〜3次及び1次〜5次二重モードSAWフィルタを大幅に小型に構成することができるという優れた効果を奏する。

【図面の簡単な説明】

【図1】本発明に係る第1の実施例の縦線接続型1次〜3次縦結合二重モードSAWフィルタのレイアウト構成である。

【図2】本発明に係る第2の実施例の縦線接続型1次〜3次縦結合二重モードSAWフィルタのレイアウト構成である。

【図3】本発明に係る第3の実施例の縦線接続型1次〜3次縦結合二重モードSAWフィルタのレイアウト構成である。

【図4】本発明に係る第4の実施例の縦線接続型1次〜3次縦結合二重モードSAWフィルタのレイアウト構成である。

【図5】本発明に係る第5の実施例の縦線接続型1次〜3次縦結合二重モードSAWフィルタのレイアウト構成である。

【図6】本発明に係る第6の実施例で、I D T電極間にミドルグレーティングを挟んだ縦線接続型1次〜3次縦

結合二重モードSAWフィルタのレイアウト構成である。

【図7】本発明に係る第7の実施例で、5個のIDT電極を用いた縦属接続型1次～5次縦結合二重モードSAWフィルタのレイアウト構成である。

【図8】従来の縦結合1次～3次二重モードSAWフィルタの電極構成の一例を示す平面図である。

【図9】従来の縦属接続型縦結合1次～3次二重モードSAWフィルタの電極構成の一例を示す平面図である。

【図10】従来の縦属接続型縦結合1次～3次二重モードSAWフィルタの共振特性の一例を示す図である。

【図11】浮き電極型内部反射方向性IDT電極（FEUDT）を用いたトランスバーサルSAWフィルタの

一電極構成を示す平面図である。

【図12】FEUDTトランスバーサルSAWフィルタの共振特性一例を示す図である。

【符号の説明】

1、2、3、4、5・・・IDT電極

Ra、Rb・・・反射器

IN・・・入力

OUT・・・出力

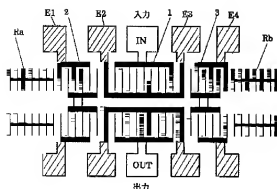
Ma、Mb・・・ミドルグレーティング

E1、E2、E3、E4、E5、E6、E7、E8、E

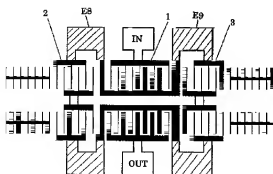
9、E10、E11、E12、E13、E14、E1

5、E16、・・・アース電位のボンディングパッド

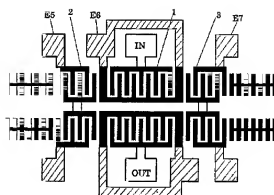
【図1】



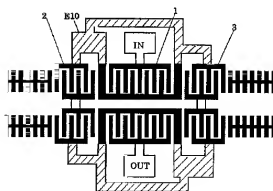
【図3】



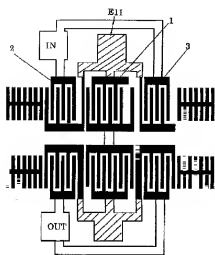
【図2】



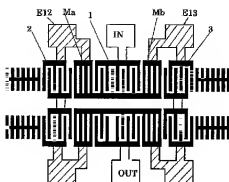
【図4】



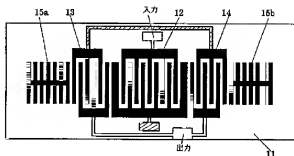
【図5】



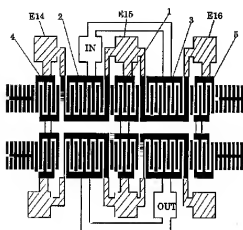
【図6】



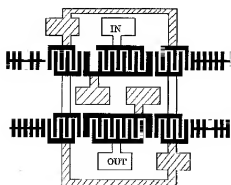
【図8】



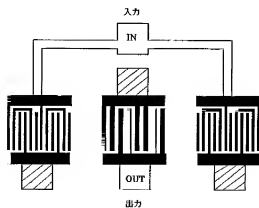
【図7】



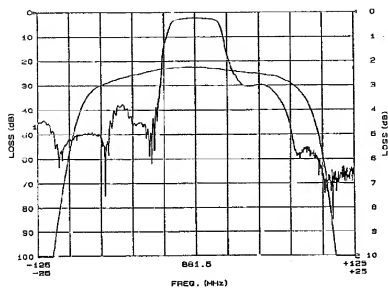
【図9】



【図11】



【図10】



【図12】

